INDIANA DEPARTMENT OF TRANSPORTATION

INTER-DEPARTMENT COMMUNICATION

Standards Section -- Room N642
Writer's Direct Line:
(317) 232-5347

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DESIGN MEMORANDUM No. 99-18
TECHNICAL ADVISORY

TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: */s/Richard L. VanCleave*
Richard L. VanCleave
Design Policy Engineer
Contracts & Construction Division

RE: **Underdrain Table**
Connection of Underdrain Pipe to Inlet Structures

Recently, Design Memo #99-13 was published to announce revisions to design procedures related to underdrains. Implementation of the new procedures requires that additional information be shown on the Underdrain Table.

A revised Underdrain Table has been developed. Unfortunately, electronic copies of the sheet frame are not yet available. However, the Microsoft Excel spreadsheet used to develop the new table is available on the Standards Section internet home page. The address is www.state.in.us/dot/TS/standards/memos/memos.htm. The Excel file contains a master spreadsheet that can be used to create a sheet frame and two example sheets that illustrate how data is to be presented by the new table. When the official sheet frame development is complete, it will be posted in the Design Division library and on the Standards Section internet home page.

The following is a discussion of preparation requirements for the revised Underdrain Table. The new table consists of three parts. One section of the table is dedicated to data related to underdrain pipe. The second portion of the table contains the data associated with outlet pipe. The final table section includes data related to outlet protectors.

UNDERDRAIN PIPE

This portion of the sheet indicates that an underdrain pipe is to be installed from Point A to Point B, includes the flow line elevation at these locations, and identifies which end(s) of the underdrain pipe require(s) an outlet pipe. Quantities for pay items related to the underdrain pipe installation are also summarized on this portion of the sheet.

1. **Column 1, Underdrain Pipe Limits**—In this column, the station limits of individual pipes are entered.
2. **Columns 2a and 2b, Type 4 Pipe**—The quantity of 100 mm or 150 mm Type 4 Pipe required for each underdrain pipe is entered in the appropriate column.
3. **Column 3, Geotextile for Underdrains**—If geotextile for underdrains is required for an underdrain pipe installation, the quantity is noted in this column.
4. **Column 4, Aggregate for Underdrains**—The quantity of aggregate for underdrains associated with each underdrain pipe is listed in this column.
5. **Column 5, HMA for Underdrains**—If an underdrain pipe requires HMA to patch an existing asphalt shoulder, the quantity is noted in this column.
6. **Column 6, Special Grade**—If an underdrain pipe is to be installed at a special grade, the magnitude of the grade, in percent, is entered in this column.
7. **Column 7, Flow Line Elevation @ Underdrain Pipe Limit**—The underdrain pipe flow line elevations at the underdrain pipe limits are indicated in this column.
8. **Column 8, Outlet Pipe Required**—In this column, a "Y" or an "N" is entered to indicate whether or not an outlet pipe is required at each underdrain pipe limit.
9. **Column 9, Connect Underdrain Pipe to Structure No. __**—If an underdrain pipe is to be connected directly to a drainage structure, the structure number is recorded in this column.
10. **Column 10, Structure Invert Elevation**—If a structure number is recorded in Column 9, the invert elevation of the drainage structure is noted in this column. This elevation can be compared to the column 7 entry to verify that the drainage structure provides a positive outlet for the underdrain pipe.

OUTLET PIPE

This section of the table indicates the required outlet pipe length, location, outlet elevation, and whether the outlet

pipe outfall occurs at an outlet protector or at a drainage structure. Quantities for pay items related to outlet pipe installation are also shown on this portion of the table.

11. **Column 11, 45 Degree Elbows Required (1 or 2)**—If a "Y" has been entered in Column 8, this column is used to indicate whether one or two 45° elbows are required in the connection of the underdrain pipe and outlet pipe.
12. **Column 12, 150 mm Outlet Pipe**—The quantity of outlet pipe required is entered in this column.
13. **Column 13, Outlet Station**—For outlet pipes that outfall at an outlet protector, the centerline station of the protector is entered in this column. For outlet pipes that are connected to drainage structures, the drainage structure station is entered in this column.
14. **Column 14, Outlet Elevation**—The outlet pipe flow line elevation at the outlet protector outfall or drainage structure connection is recorded in this column.
15. **Column 15, Outlet at Outlet Protector No.__**—If the outlet pipe outfall is at an outlet protector, the number of the outlet protector is recorded in this column. Outlet protectors should be numbered in the following manner, OP—1, OP—2, OP—3, etc.
16. **Column 16, Ditch Flow Line Elevation at Outlet Protector**—If the outlet pipe outfall is at an outlet protector, the ditch flow line elevation at that location is entered into this column. This entry can be compared to the elevation in column 14 to verify that the ditch provides a positive outlet for the outlet pipe.
17. **Column 17, Connect Outlet Pipe to Structure No.__**—If the outlet pipe is to be connected to a drainage structure, the number of that structure is recorded in this column.
18. **Column 18, Structure Invert Elevation**—If the outlet pipe is connected to a drainage structure, the invert elevation of the structure is noted in this column. This entry can be compared to the elevation entered in column 14 to verify that the drainage structure provides a positive outlet for the outlet pipe.
19. **Column 19, B Borrow for Structure Backfill**—The quantity of B borrow for structure backfill required for the outlet pipe trench is recorded in this column.
20. **Column 20, HMA for Underdrains**—If required to patch asphalt shoulders above the outlet pipe trench, the quantity of HMA is included in this column.

OUTLET PROTECTORS

The type and location of individual outlet protectors are contained in this portion of the Underdrain Table.

21. **Column 21, Outlet Protector No.___**—The Outlet Protector Number is entered in this column.
22. **Column 22, Outlet Protector Type**—The type of outlet protector required for the protector number noted in Column 21 is entered.
23. **Columns 23a, 23b, 23c, and 23d, Location**—The location of the outlet protector entered in Column 21 is entered in the appropriate column.

SHEET PREPARATION GUIDELINES

While entering the data described above, these rules should be followed.

1. **Underdrain Pipe Limit Determination**—First of all, it is usually acceptable to determine underdrain pipe limits to the nearest meter. Secondly, it is acceptable to designate one location as the ending station for one underdrain pipe and the beginning station for an adjacent underdrain pipe. As a general rule, if adjacent underdrain pipes are connected to a drainage structure, the drainage structure location should be entered as the ending station for the first underdrain pipe and the beginning station for the second underdrain pipe. If adjacent underdrain pipes are connected to outlet pipes that share an outlet protector, the ending station and beginning station for the respective pipes should be determined in a similar manner as the outlet station assigned for outlet pipes sharing a common outlet protector. The centerline station between the outlet pipes should be used as the ending station for the first pipe and the beginning station for the second pipe. Please refer to the sample Underdrain Tables included in the Microsoft Excel file for examples related to underdrain pipe limit determination.
2. **Outlet Protector Identification**—Outlet protectors are now assigned numbers in a manner similar to drainage structures. In order to differentiate the outlet protector numbering system from those for other project elements, outlet protector numbers should be

of an "OP-__" format. Underdrain Table column 15 is used to identify the outlet protector that is connected to individual outlet pipes. If two outlet pipes utilize the same outlet protector, that outlet protector number is entered in column 15 for both outlet pipes. Underdrain Table columns 21 through 23 contain data related to the type and location of each outlet protector. Regardless of the number of outlet pipes contained by an outlet protector, it is only necessary to input outlet protector identification and location data once. Again, please refer to the sample Underdrain Tables included in the Microsoft Excel file for examples related to outlet protector identification.

CONNECTION OF UNDERDRAIN PIPE TO INLET STRUCTRUES

One topic discussed in the Design Memo #99-13 Policy Change and Technical Advisory documents was the direct connection of underdrain pipe to inlets or other storm drain system structures. However, it has since been pointed out that details for some standard inlets include structure depth dimensions that are too shallow for a standard underdrain pipe installation to be connected to the inlet and still meet freeboard requirements.

This does not change the intent of the preferred design. Inlets located along the normal alignment of an underdrain pipe should be used as the outlet for the pipe. If the standard depth for such a structure is insufficient to provide a satisfactory outlet, the designer should add a "modified" designation to the standard inlet type on all plan callouts for that structure. The pay item description for that structure should be of the following format—"Inlet, _____, Modified". Development of a plan detail for a modified inlet is not required, but it is necessary that invert elevation entries for the structure shown on the Structure Data Sheet reflect what is required to drain the underdrain pipe and meet freeboard requirements.

If you have any questions or comments related to this subject, please do not hesitate to contact me.

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